

FIELD GUIDEBOOK
to
ENVIRONMENTS OF COAL FORMATION
IN
SOUTHERN FLORIDA

Trip Leaders
William Spackman
David W. Scholl and William H. Taft

Printed for the
GEOLOGICAL SOCIETY OF AMERICA
PRE-CONVENTION FIELDTRIP
November 16, 17, 18, 1964

interpretation is correct. In this photograph the typical hammock and glade physiognomy is partially obliterated by the numerous mangrove trees that become more abundant and larger as one progresses toward the south. This suggests that the mangrove forest has been superimposed on the hammock and marsh environmental complex, after the latter was well-developed. It is difficult to conceive of the synchronous development of these three components.

STOP 4: Saw Grass Site

Objectives:

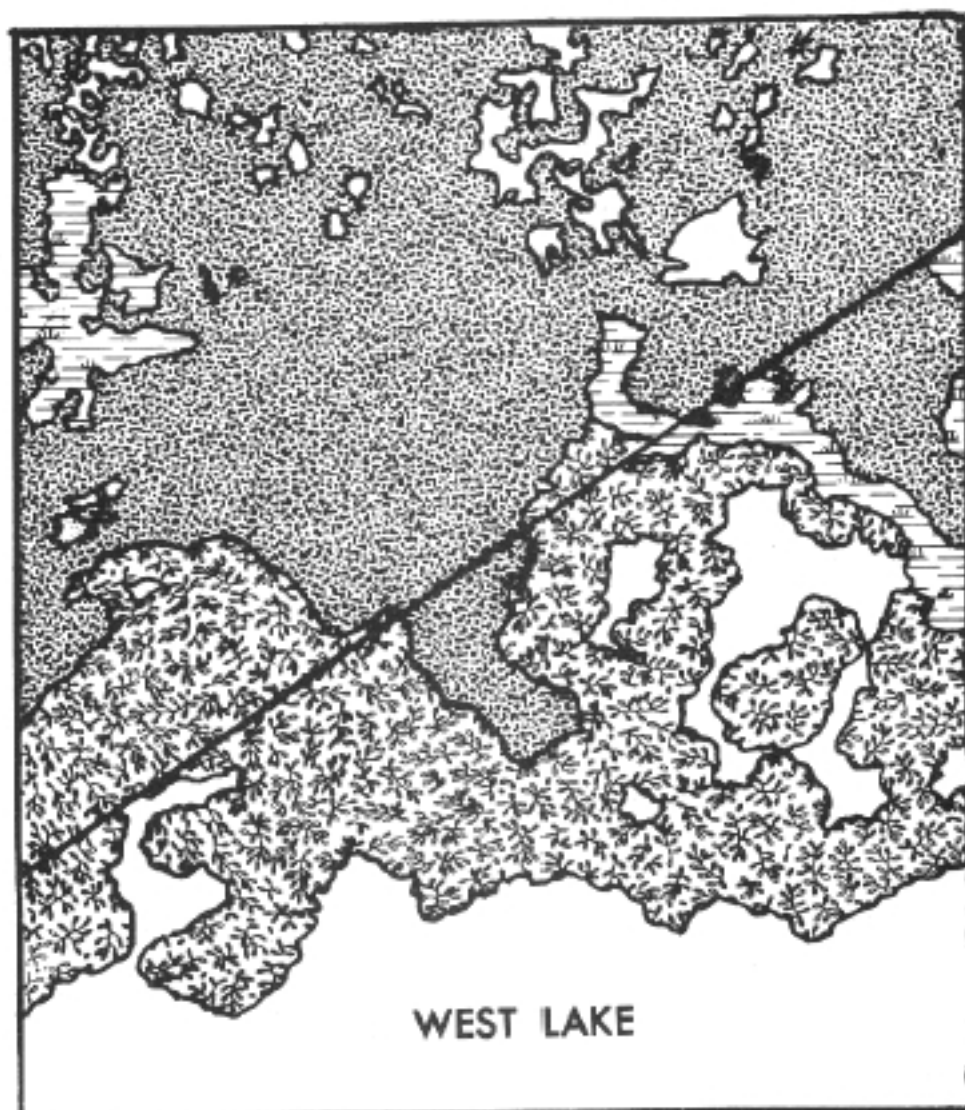
- A. Inspection of saw grass environment, saw grass surface litter and saw grass peat.
- B. Discussion of marsh environments.
- C. Discussion of element concentration and the pollen and spore content in saw grass peat.

Discussion:

Areally the saw grass marsh is the most important environment in south Florida. It is also the most important peat-forming environment accounting for at least 400,000,000 tons of Florida's available peat reserves.

The general setting in which Stop 4 is located is not typical of either the Saw Grass Plains to the north or the Ridge and Slough Sector to the west. The site is located in a small patch of saw grass that is merely a remnant of the saw grass marsh that occupied this general area in the past. It is surrounded by a mangrove forest that has engulfed the hammocks of the area and destroyed the saw grass glades. In spite of these facts, the saw grass at the site itself forms a vigorous growth of closely spaced plants that is quite similar to that encountered in more typical settings. Moreover, the peat at the site appears quite comparable to that examined in sites in the Slough area and in the Plains to the north. In view of this, inspection of the site will provide much of the desired information on this type of marsh environment.

Figure 13 depicts the areal relationships of the major environments in this vicinity. The surrounding area includes a swamp dominated by



1/2 mile

LEGEND

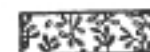
MARSH

WHITE MANGROVE

MANGROVE POND

RED MANGROVE

OPEN WATER



MAP OF ENVIRONMENTS IN THE WEST LAKE AREA

Figure 13

the red mangrove (Rhizophora mangle L.) with occasional specimens of white mangrove (Laguncularia racemosa Gaertn.), black mangrove (Avicennia nitida Jacq.) and buttonwood (Conocarpus erectus L.). Also included is an area designated "White Mangrove Swamp Environment" that is more open in aspect and is dominated by small white mangroves. This is not a major environment when the region is considered in its entirety, for mature white mangroves seldom form pure stands that occupy large areas. They appear able to colonize areas laid bare by hurricanes before other mangroves are able to get started and temporarily they dominate the scene and perhaps influence the nature of the environment. Their influence appears to be local and short-lived but more data are needed before such areas are regarded as unimportant components of the mangrove swamp complex. Another environment that is of interest in this general area is here designated the "Mangrove Pond Environment". One such environment is shown just beyond the road in Plate VII and some indication of their frequency in certain localities may be obtained from inspection of the northwestern quarter of Figure 13. This type of open water environment typically contains one or more clumps of red mangrove in the shallow pond area. Its features will be discussed further on subsequent pages.

Although emphasis has been given to the importance of the saw grass environment, it should be recognized also that the marshland areas include several other spatially significant environments. Among these are:

1. The Spike-Rush Marsh
2. The Bulrush Marsh
3. The Cattail Marsh
4. The Salt Grass Marsh

The spike-rush and bulrush environments are particularly important in the Ridge and Slough Sector northeast of the headwaters of the Shark River and, in fact, in the entire southern section of the Everglades.

The spike-rush or Eleocharis environment is developed in areas in which the water is slightly deeper in the wet season than it is in the saw grass environment. The sparse cover provided by the Eleocharis



PLATE VII

permits development of the algal mat. As previously mentioned, these areas are sites in which marl is deposited as opposed to peat. As shown in Plate VIII, these areas are extensive and their boundaries are well-defined. In the Ridge and Slough Sector these environments appear to develop on saw grass peat surfaces in a manner that is still unknown. The depression of the area and destruction of the saw grass cover may be related to fire, differential peat compaction, changes in the surficial drainage pattern, differential solution of the underlying bedrock, or some complex combination of these and other factors. A few inches of difference in water depth is all that appears to separate the two environments but the size of the areas involved is often to be measured in terms of acres and sometimes in terms of square miles. It seems probable that a rather delicate balance between the rate of subsidence and the rate of peat accumulation must obtain in order to maintain the saw grass marsh. If the rate of subsidence (or water table rise) is too slow, the site may become drier and drier as the result of peat build-up, until it may permit the entry of hardwoods and the subsequent destruction of the marsh. This does not appear to have happened in any of the areas with which we are concerned. On the other hand, if the rate of subsidence (or water table rise) is too fast, during some prolonged unit of time the "water depth tolerance" of saw grass might be exceeded over sizeable areas and the *Eleocharis* environment would develop on the saw grass peat surface. Soon the algal mat would form and a layer of marl would begin to develop. This development might continue until the area had been built up to a level that would permit repopulation by saw grass. After repopulation, saw grass peat might again accumulate burying a lens of marl between two saw grass peat layers, forming a sequence similar to occurrences encountered in coring the Ridge and Slough and adjacent areas.

Apart from such hypothetical considerations as those discussed above, it is clear that marl and not peat is deposited in the *Eleocharis* environment. In contrast with this, the other marsh environments are often sites of peat accumulation but the peat and the geochemical conditions appear to differ from those characteristic of the saw grass areas.



a



b

PLATE VIII

Saw grass peat is a very black material that is homogeneous in appearance when examined with the naked eye. Because of the nature of the source material, it is devoid of any woody, fibrous, or coarse granular texture and is grossly amorphous. In view of the abundance of silica in the leaf blades (being present in the saw tooth margin and over some of the leaf veins), it is remarkable that the peat does not show a concentration of this element (Figure 14). Instead, the sulfur content is unusually high and the magnesium content appears to be somewhat above that which might be expected. In view of the frequent proximity of environments in which calcium is concentrated in large quantities, it is interesting that saw grass peats usually exhibit low calcium contents.

The pollen and spore content of saw grass peat is as distinctive as that of cypress peat. As is evident from Figure 16, the nature of the assemblage could not be readily inferred from a knowledge of the vegetative cover, but again the environment provides a "signature" assemblage in the preserved pollen record. Detailed studies in saw grass areas have shown that the presence of adjacent plant communities can be detected by the inspection of several samples from a transect and the general location of the adjacent environment can be identified.

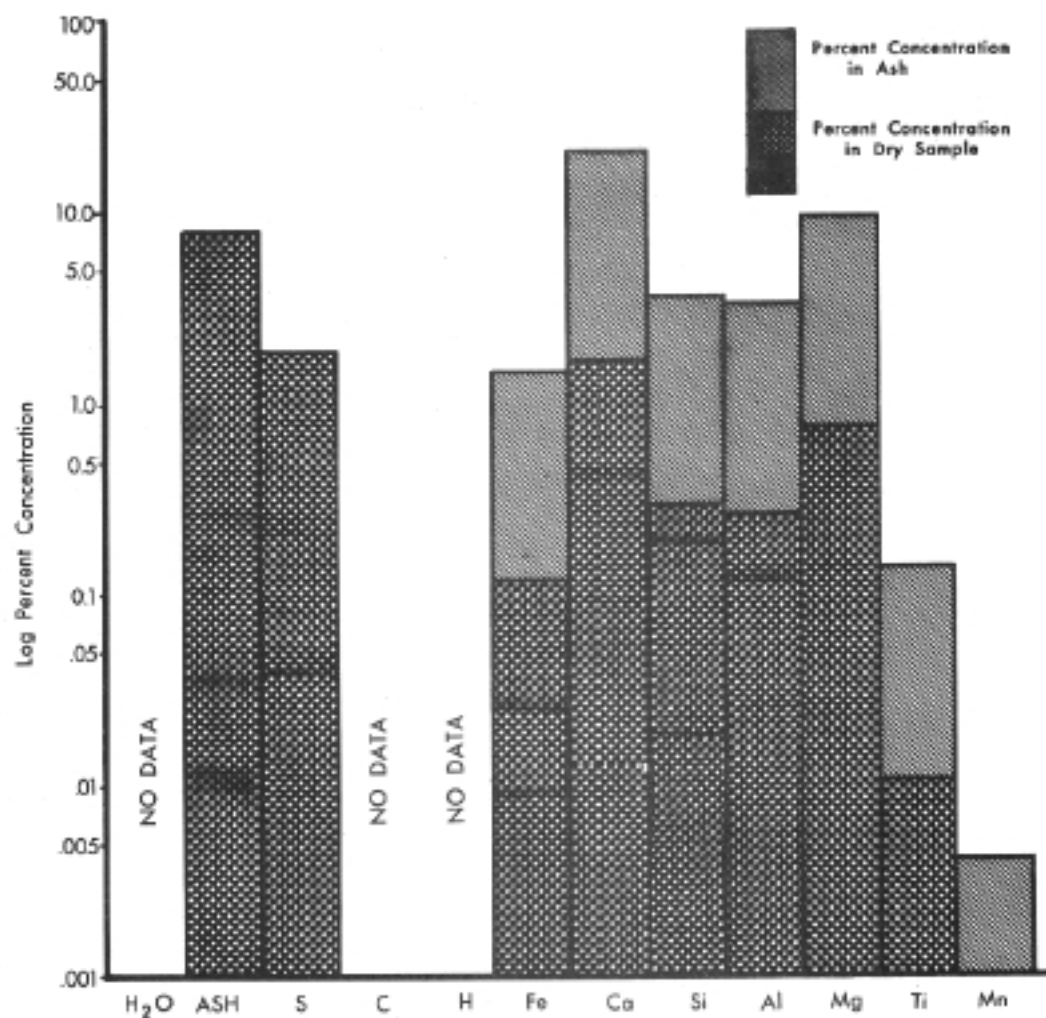
STOP 7: East River Site - Mangrove Pond Environment

Objectives:

- A. Inspection of one type of open water site in the red mangrove environment.
- B. Inspection and discussion of "liver mud" in terms of its origin, nature and future fate in an organic sediment.
- C. Discussion of the sediment bordering the northeastern margin of Whitewater Bay.

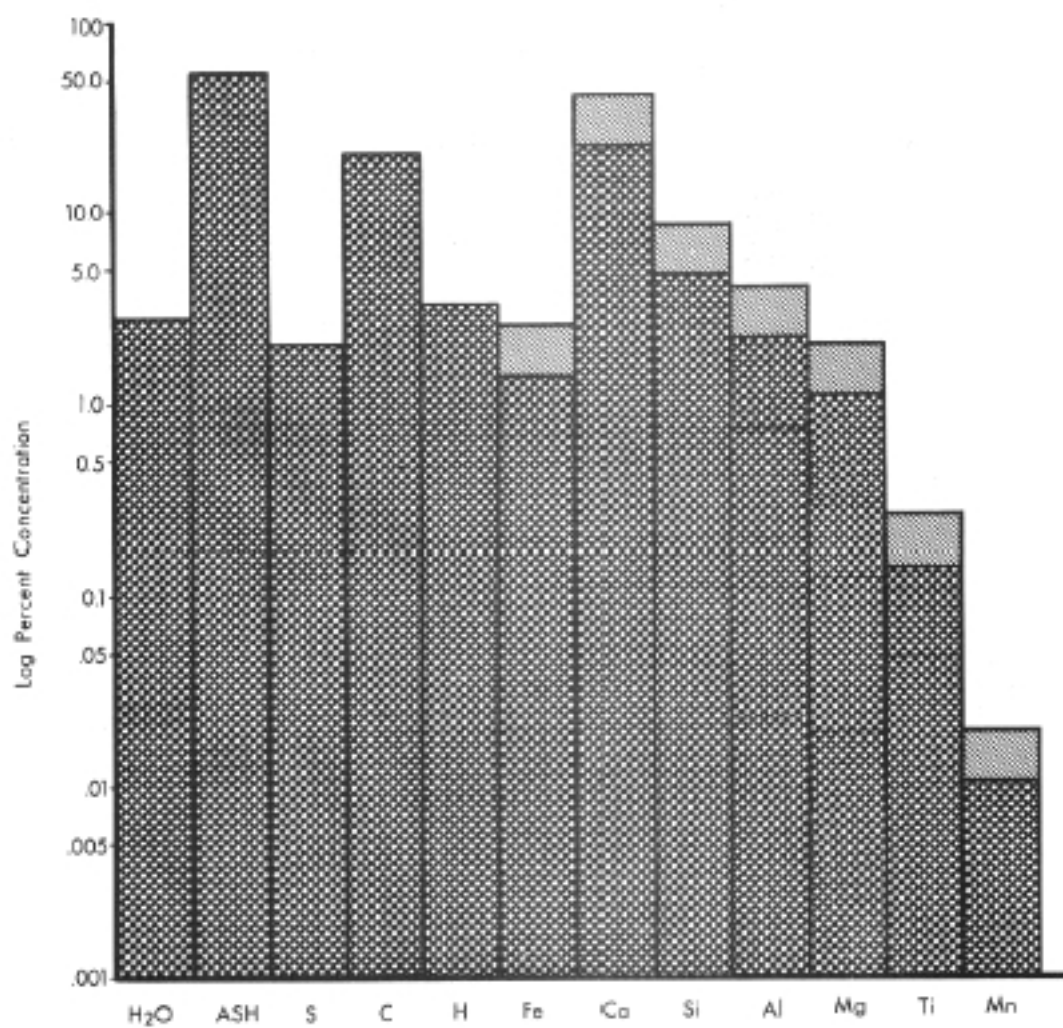
Discussion:

The Mangrove Pond is a common feature of the Mangrove Swamp Environmental Complex. Those that occur northeast of Whitewater Bay are in, or adjacent to, the transition zone that separates the mangrove



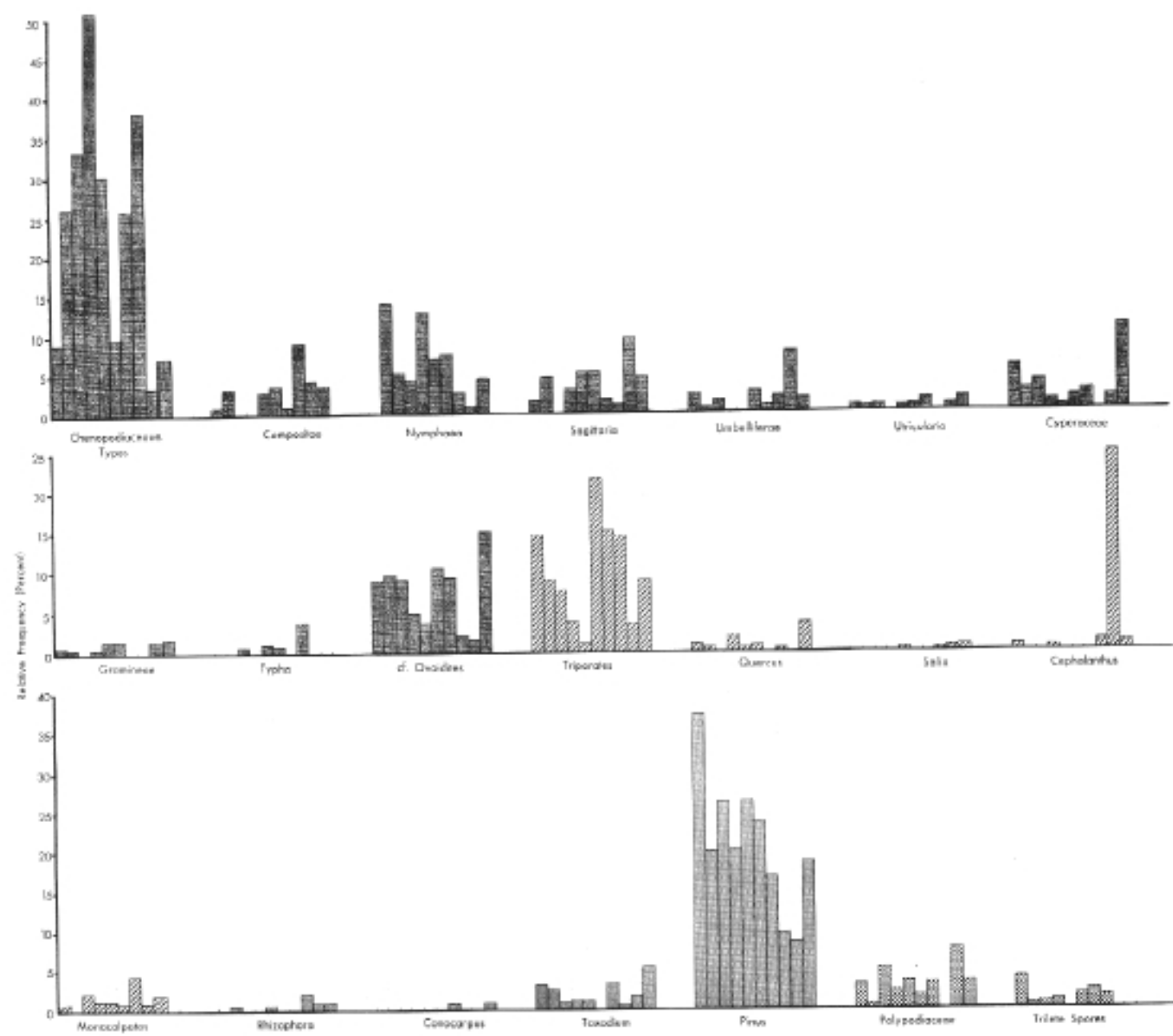
ELEMENT CONCENTRATIONS IN SAW GRASS PEAT

Figure 14



ELEMENT CONCENTRATIONS IN "LIVER MUD"

Figure 15



POLLEN AND SPORE CONTENT OF SEDIMENT FROM MARSH ENVIRONMENT

Figure 16

swamp from the open Everglades. Figure 17 shows the distribution of the Ponds in the vicinity of Stop 7. The extent to which the ponds are interconnected is greater than that shown, particularly when the water level is high. The figure also shows the presence of "transitional environments" in which the surface is covered with a mixed red mangrove-saw grass growth. Plate IX shows an aerial view of the actual site and its relationship to East River and Whitewater Bay.

The origin of these open water areas has not been explained and as yet the "on shore" peat has not been studied in detail. Such ponds may be simply the product of the incomplete colonization by red mangrove of an area that has recently undergone rapid inundation with somewhat saline waters. Although seemingly shallow because of the accumulation of non-compacted recent sediment, the pond basins and associated river channels are deeper than one might expect, if the relatively flat saw grass marsh were simply inundated by the inland effects of marine transgression. Figure 18 shows a sectional profile across East River near the location of Stop 7. From this it is evident that the Ponds are bordered on all sides by a relatively thick peat layer. The basins are, in fact, depressions or holes in the peat blanket.

The Ponds usually contain two types of recently deposited sediment. The basal sediment is usually a light colored marl. On this marl rests a peculiar suspension that conforms in many ways to the material termed "liver mud" by Davis (1940). When held on the end of a paddle or shovel it is coherent but responds as would a mass of jelly to any sharp movement of the supporting object.

Vast quantities of this "liver mud" exist in the innumerable Mangrove Ponds in this area. It appears to be a mixture of organic and inorganic material, the latter being mainly calcium carbonate. In addition to the presence of large concentrations of calcium, the elemental analyses show that this material also contains relatively high concentrations of sulfur and manganese (see Figure 15). The composition of this material will be discussed further in connection with description of the Whitewater Bay sediments.

The source of this "liver mud" has not been fully established, but it seems probable that the peat fraction is derived from the chemical



LEGEND

$\frac{1}{2}$ mile

MANGROVE POND
DWARF MANGROVE
TRANSITIONAL

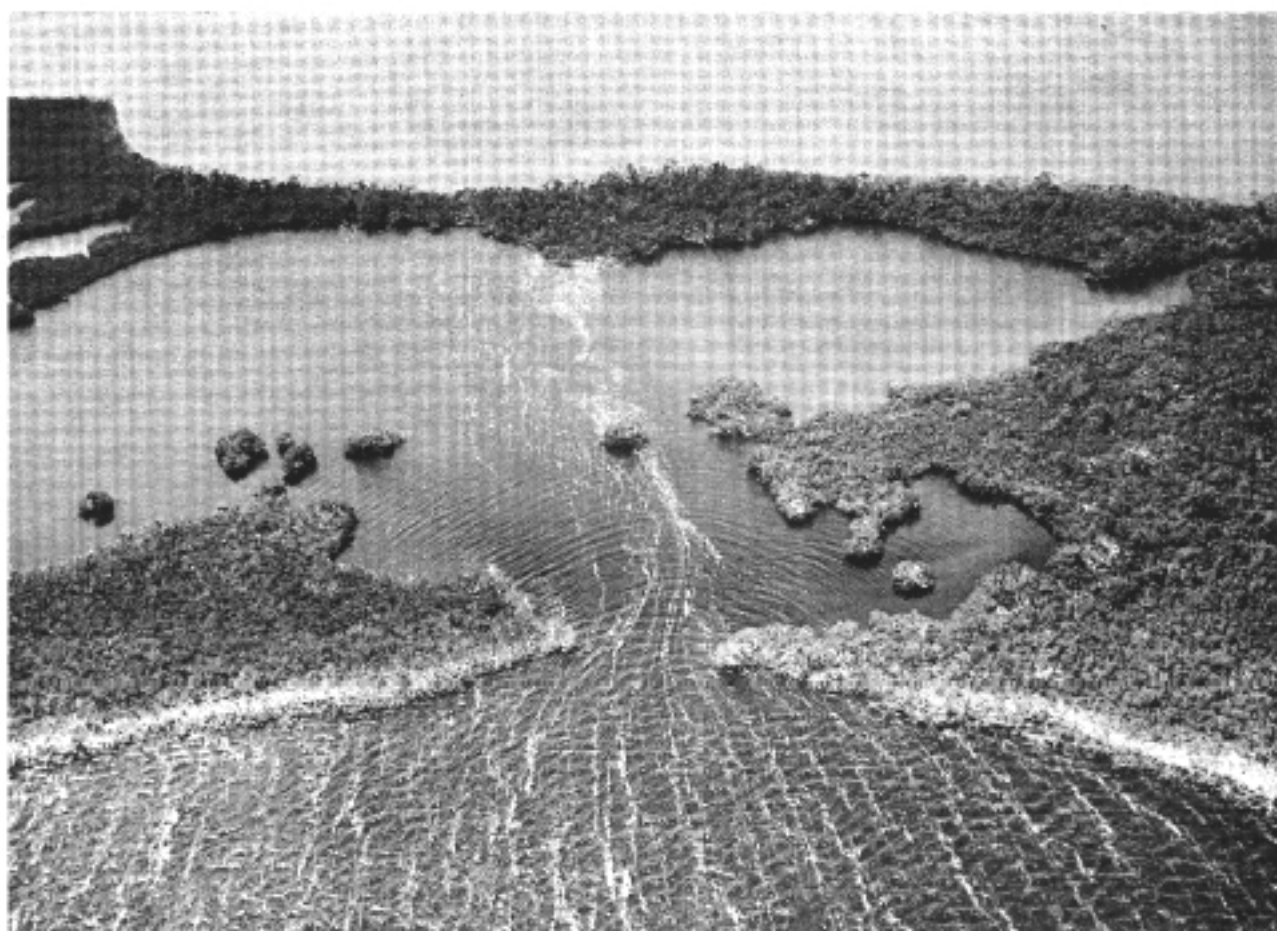


MAP OF ENVIRONMENTS IN THE EAST RIVER AREA

Figure 17

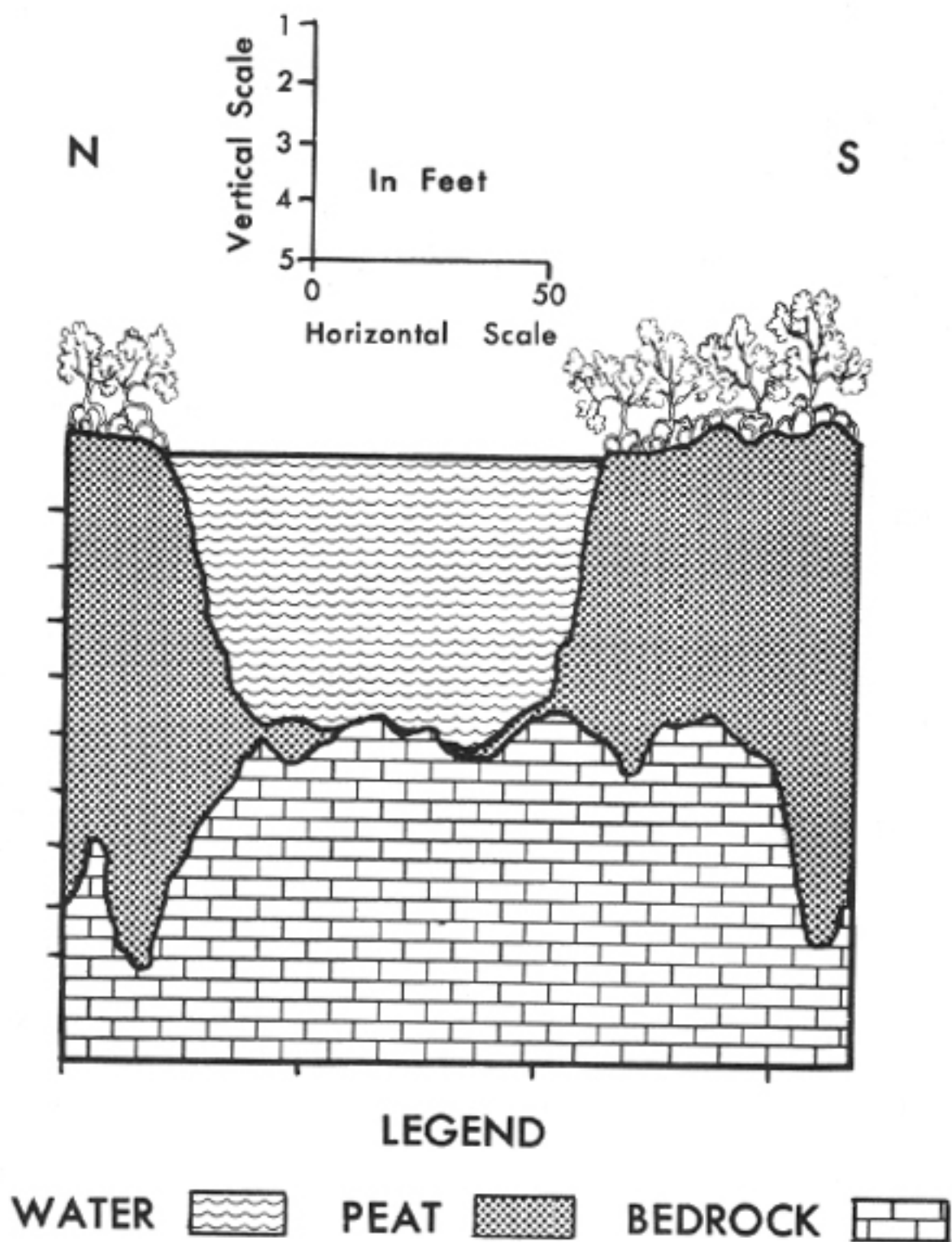


a



b

PLATE IX



SECTIONAL PROFILE ACROSS EAST RIVER

Figure 18

and physical degradation of the surface peat in the nearby areas. As one travels through the Hell's Bay area, small, steep-sided, mounds of peat are encountered. Saw grass grows on the surface of these blocks at an elevation that is commonly one foot above the general level on which the dwarf mangrove grows. The sides of the blocks of peat are torn and irregular, indicating they are erosional and not depositional features. It is suggested that the marine transgression implied by the previously observed vegetational relationships is further documented by these remnant peat blocks and the presence of the liver mud. The invading saline water reduces the suitability of the habitat as far as vigorous saw grass growth is concerned and this may result in a reduction in the health and number of individual plants. The rapid advance of the mangrove forest and the coverage of the area with young mangroves is inhibited, however, until tidal water can flow over the surface and carry the seedling plants inland. During the initial period of transgression when tidal flow merely moved the salinity contours landward or when it caused only an inch of water to flow over the surface, the mangroves' advance would still be inhibited but erosion of the loose, fine-grained surface peat could easily be affected. By this means the surface in small areas would be lowered, permitting increased effectiveness as far as further erosion by tidal flow would be concerned. After the surface was lowered sufficiently, the mangrove seedlings could float freely into the area and colonize it completely. Further lowering of the surface would proceed, however, until the mangrove rootlets had bound the upper peat layer to the point of immobility.

If the above approximates the truth, the occurrence of an occasional remnant peat mound would be inevitable until the entire surface was reduced to a level below normal high tide. Moreover, the products of erosion should be found in the immediate area for some time, because of the nature of the process. Further, the degraded peat material should be mixed with any material being brought into the area by fresh water flow. The "liver mud" seems to be a mixture of degraded peat and fresh water marl and it occurs in all quiet, open water areas in the Hell's Bay region. It is postulated that this sediment contains the erosional

products of the surface lowering process that has been active in the recent past and may still be operative in this brackish water zone.

The pollen content of a core taken through the liver mud in a Mangrove Pond is presented as Figure 19. Because this material appears to be secondarily deposited and because of the flocculent nature of the sediment, it is questionable as to whether one should attempt to reconstruct the area's history from the superposed pollen assemblages. The abundances of pine, chenopodiaceous pollen, buttonwood and myrtle in the core indicate collectively and individually that the sediment is foreign to the environment in which it is now found. Perhaps coincidentally the upper two inches contains high concentrations of Conocarpus and Myrica and a small percentage of Rhizophora, suggesting a trend in the direction of representing the present vegetation.

STOP 8: Midway Key

Objectives:

- A. Demonstration of sample collecting techniques.
- B. Inspection of red mangrove peat.
- C. Discussion of the form and composition of Whitewater Bay islands.
- D. Discussion of island destruction..

Discussion:

Reference to the trip map (Trip Map No. 1) will show that Stop 8 is located near the center of the shallow open water area known as Whitewater Bay. Comparison of the map (Figure 20) with the photograph of the site (Plate IXb) will show that the small isthmus depicted on the map on the east side of the large north island (the map was taken from a 1953 aerial photograph) has been destroyed within the last ten years. A similar event can be documented in the case of several other islands. This suggests that island dissection may be another erosional process associated with the aforementioned marine transgression.

Whitewater Bay contains a large number of islands, varying in size from a few square yards to many acres. These islands are blocks of peat standing either on the bedrock floor or on a thin layer of marl. The